Communicating Processes

$c!\,2 \;\|\; (c?.\; x{:=}\,c)$

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$$= \quad \mathcal{M}_{\boldsymbol{w}} = 2 \;\wedge\; (\boldsymbol{w}{:=}\,\boldsymbol{w}{+}1) \;\|\; (\boldsymbol{r}{:=}\,\boldsymbol{r}{+}1.\;\; x{:=}\,\mathcal{M}_{\boldsymbol{r}-1})$$

Communicating Processes

$$c!\,2 \;\|\; (c?.\; x{:=}\,c)$$

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$$= \quad \mathcal{M}_{\boldsymbol{w}} = 2 \;\wedge\; \boldsymbol{w}' = \boldsymbol{w}{+}1 \;\wedge\; \boldsymbol{r}' = \boldsymbol{r}{+}1 \;\wedge\; x' = \mathcal{M}_{\boldsymbol{r}}$$

Communicating Processes

$$c!\ 2\ \|\ (c?.\ x{:=}\ c)$$

$$=\quad \mathcal{M}_{\boldsymbol{w}} = 2\ \wedge\ (\boldsymbol{w}{:=}\ \boldsymbol{w}{+}1)\ \|\ (\boldsymbol{r}{:=}\ \boldsymbol{r}{+}1.\ x{:=}\ \mathcal{M}_{\boldsymbol{r}-1})$$

$$=\quad \mathcal{M}_{\boldsymbol{w}} = 2\ \wedge\ \boldsymbol{w}' = \boldsymbol{w}{+}1\ \wedge\ \boldsymbol{r}' = \boldsymbol{r}{+}1\ \wedge\ x' = \mathcal{M}_{\boldsymbol{r}}$$

$$c!\ 1.\ (c!\ 2\ \|\ (c?.\ x{:=}\ c)).\ c?$$

Communicating Processes

$$c!\ 2 \ \| \ (c?.\ x{:=}\ c)$$

$$= \quad \mathcal{M}_{\boldsymbol{w}} = 2 \ \wedge\ (\boldsymbol{w}{:=}\ \boldsymbol{w}{+}1) \,\|\, (\boldsymbol{r}{:=}\ \boldsymbol{r}{+}1.\ x{:=}\ \mathcal{M}_{\boldsymbol{r}-1})$$

$$= \quad \mathcal{M}_{\boldsymbol{w}} = 2 \ \wedge\ \boldsymbol{w}' = \boldsymbol{w}{+}1 \ \wedge\ \boldsymbol{r}' = \boldsymbol{r}{+}1 \ \wedge\ x' = \mathcal{M}_{\boldsymbol{r}}$$

$$c!\ 1.\ (c!\ 2 \ \| \ (c?.\ x{:=}\ c)).\ c?$$

channel declaration

Communicating Processes

$$c!\ 2 \ \|\ (c?.\ x{:=}\ c)$$

$$= \quad \mathcal{M}_{\boldsymbol{w}} = 2 \ \land\ (\boldsymbol{w}{:=}\ \boldsymbol{w}{+}1) \,\|\, (\boldsymbol{r}{:=}\ \boldsymbol{r}{+}1.\ x{:=}\ \mathcal{M}_{\boldsymbol{r}-1})$$

$$= \quad \mathcal{M}_{\boldsymbol{w}} = 2 \ \land\ \boldsymbol{w}' = \boldsymbol{w}{+}1 \ \land\ \boldsymbol{r}' = \boldsymbol{r}{+}1 \ \land\ x' = \mathcal{M}_{\boldsymbol{r}}$$

$$c!\ 1.\ (c!\ 2 \ \|\ (c?.\ x{:=}\ c)).\ c?$$

channel declaration

chan c: T· P

Communicating Processes

$$c!\ 2\ \|\ (c?.\ x{:=}\ c)$$

$$=\quad \mathcal{M}_{\boldsymbol{w}} = 2\ \land\ (\boldsymbol{w}{:=}\ \boldsymbol{w}{+}1)\ \|\ (\boldsymbol{r}{:=}\ \boldsymbol{r}{+}1.\ x{:=}\ \mathcal{M}_{\boldsymbol{r}-1}\ )$$

$$=\quad \mathcal{M}_{\boldsymbol{w}} = 2\ \land\ \boldsymbol{w}' = \boldsymbol{w}{+}1\ \land\ \boldsymbol{r}' = \boldsymbol{r}{+}1\ \land\ x' = \mathcal{M}_{\boldsymbol{r}}$$

$$c!\ 1.\ (c!\ 2\ \|\ (c?.\ x{:=}\ c)).\ c?$$

channel declaration

$$\textbf{chan}\ c{:}\ T\cdot\ P$$

$$=\quad \exists \mathcal{M}c{:}\ \infty{*}T\cdot\ \exists \mathcal{T}c{:}\ \infty{*}xnat\cdot\ \textbf{var}\ \boldsymbol{r}c\ ,\ \boldsymbol{w}c{:}\ xnat := 0\cdot\ \ P$$

ignoring time

chan c: int· c! 2 $\|$ (c?. x:= c)

ignoring time

$\textbf{chan } c{:}\ int\cdot\ \ c!\,2\ \ \|\ \ (c?.\ \ x{:}{=}\ c)$

$=\qquad \exists\mathcal{M}{:}\ \infty{*}int\cdot\ \textbf{var } \boldsymbol{r}, \boldsymbol{w}{:}\ xnat := 0\cdot$

$x' = \mathcal{M}_{\boldsymbol{r}}\ \land\ \mathcal{M}_{\boldsymbol{w}} = 2\ \land\ \boldsymbol{r}' = \boldsymbol{r}{+}1\ \land\ \boldsymbol{w}' = \boldsymbol{w}{+}1\ \land$ (other variables unchanged)

ignoring time

$\textbf{chan}\ c: int\cdot\ \ c!\ 2\ \ \|\ \ (c?.\ \ x{:=}\ c)$

$=\quad \exists\mathcal{M}: \infty{*}int\cdot\ \textbf{var}\ \boldsymbol{r}, \boldsymbol{w}: xnat := 0\cdot$

$x' = \mathcal{M}_{\boldsymbol{r}}\ \land\ \mathcal{M}_{\boldsymbol{w}} = 2\ \land\ \boldsymbol{r}' = \boldsymbol{r}{+}1\ \land\ \boldsymbol{w}' = \boldsymbol{w}{+}1\ \land$ (other variables unchanged)

$=\quad \exists\mathcal{M}: \infty{*}int\cdot\ \textbf{var}\ \boldsymbol{r}, \boldsymbol{w}: xnat\cdot$

$x' = \mathcal{M}_0\ \land\ \mathcal{M}_0 = 2\ \land\ \boldsymbol{r}'{=}1\ \land\ \boldsymbol{w}'{=}1\ \land$ (other variables unchanged)

ignoring time

$\textbf{chan}\ c: int\cdot\ \ c!\ 2\ \ \|\ \ (c?.\ \ x:= c)$

$=\quad \exists \mathcal{M}: \infty{*}int\cdot\ \textbf{var}\ \boldsymbol{r}, \boldsymbol{w}: xnat := 0\cdot$

$x' = \mathcal{M}_{\boldsymbol{r}}\ \land\ \mathcal{M}_{\boldsymbol{w}} = 2\ \land\ \boldsymbol{r}' = \boldsymbol{r}+1\ \land\ \boldsymbol{w}' = \boldsymbol{w}+1\ \land$ (other variables unchanged)

$=\quad \exists \mathcal{M}: \infty{*}int\cdot\ \textbf{var}\ \boldsymbol{r}, \boldsymbol{w}: xnat\cdot$

$x' = \mathcal{M}_0\ \land\ \mathcal{M}_0 = 2\ \land\ \boldsymbol{r}'=1\ \land\ \boldsymbol{w}'=1\ \land$ (other variables unchanged)

$=\quad x'=2\ \land$ (other variables unchanged)

ignoring time

$\textbf{chan}\ c: int\cdot\ \ c!\ 2\ \ \|\ \ (c?.\ \ x:=c)$

$= \quad \exists \mathcal{M}: \infty{*}int\cdot\ \textbf{var}\ \boldsymbol{r}, \boldsymbol{w}: xnat := 0\cdot$

$x' = \mathcal{M}_{\boldsymbol{r}}\ \wedge\ \mathcal{M}_{\boldsymbol{w}} = 2\ \wedge\ \boldsymbol{r}' = \boldsymbol{r}{+}1\ \wedge\ \boldsymbol{w}' = \boldsymbol{w}{+}1\ \wedge$ (other variables unchanged)

$= \quad \exists \mathcal{M}: \infty{*}int\cdot\ \textbf{var}\ \boldsymbol{r}, \boldsymbol{w}: xnat\cdot$

$x' = \mathcal{M}_0\ \wedge\ \mathcal{M}_0 = 2\ \wedge\ \boldsymbol{r}'{=}1\ \wedge\ \boldsymbol{w}'{=}1\ \wedge$ (other variables unchanged)

$= \quad x'{=}2\ \wedge$ (other variables unchanged)

$= \quad x:= 2$

ignoring time

chan c: *int*· $c!\ 2 \;\|\; (c?.\ x{:=}\ c)$

$=$ $\exists \mathcal{M}: \infty^*int\cdot$ **var** $\boldsymbol{r}, \boldsymbol{w}: xnat := 0\cdot$

$x' = \mathcal{M}_{\boldsymbol{r}} \;\wedge\; \mathcal{M}_{\boldsymbol{w}} = 2 \;\wedge\; \boldsymbol{r}' = \boldsymbol{r}{+}1 \;\wedge\; \boldsymbol{w}' = \boldsymbol{w}{+}1 \;\wedge$ (other variables unchanged)

$=$ $\exists \mathcal{M}: \infty^*int\cdot$ **var** $\boldsymbol{r}, \boldsymbol{w}: xnat\cdot$

$x' = \mathcal{M}_0 \;\wedge\; \mathcal{M}_0 = 2 \;\wedge\; \boldsymbol{r}'{=}1 \;\wedge\; \boldsymbol{w}'{=}1 \;\wedge$ (other variables unchanged)

$=$ $x'{=}2 \;\wedge$ (other variables unchanged)

$=$ $x{:=}\ 2$

including time

chan c: *int*· $c!\ 2 \;\|\; (t{:=}\ t{\uparrow}(\mathcal{T}_{\boldsymbol{r}} + 1).\ c?.\ x{:=}\ c)$

$=$ $x'{=}2 \;\wedge\; t' = t{+}1 \;\wedge$ (other variables unchanged)

Deadlock

Deadlock

chan c: $int \cdot\ t := t \uparrow (\mathcal{T}_r + 1).\ c?.\ c!\ 5$

Deadlock

$\textbf{chan } c\text{: } int\cdot \ \ t{:=}\ t\uparrow(\mathcal{T}_{\boldsymbol{r}} + 1).\ \ c?.\ \ c!\ 5$

$=\qquad \exists\mathcal{M}\text{: } \infty{*}int\cdot\ \exists\mathcal{T}\text{: } \infty{*}xnat\cdot\ \textbf{var } \boldsymbol{r}, \boldsymbol{w}\text{: } xnat := 0\cdot$

$t{:=}\ t\uparrow(\mathcal{T}_{\boldsymbol{r}} + 1).\ \ \boldsymbol{r}{:=}\ \boldsymbol{r}{+}1.\ \ \mathcal{M}_{\boldsymbol{w}} = 5\ \ \land\ \ \mathcal{T}_{\boldsymbol{w}} = t\ \ \land\ \ (\boldsymbol{w}{:=}\ \boldsymbol{w}{+}1)$

Deadlock

chan c: int· t:= t↑($\mathcal{T}_{\boldsymbol{r}}$ + 1). c?. c! 5

= ∃$\mathcal{M}$: ∞*int· ∃$\mathcal{T}$: ∞*$xnat$· **var** $\boldsymbol{r}$, $\boldsymbol{w}$: $xnat$:= 0·

t:= t↑($\mathcal{T}_{\boldsymbol{r}}$ + 1). $\boldsymbol{r}$:= $\boldsymbol{r}$+1. $\mathcal{M}_{\boldsymbol{w}}$ = 5 ∧ $\mathcal{T}_{\boldsymbol{w}}$ = t ∧ ($\boldsymbol{w}$:= $\boldsymbol{w}$+1)

= ∃$\mathcal{M}$: ∞*int· ∃$\mathcal{T}$: ∞*$xnat$· ∃$\boldsymbol{r}$, $\boldsymbol{r}'$, $\boldsymbol{w}$, $\boldsymbol{w}'$: $xnat$·

$\boldsymbol{r}$:= 0. $\boldsymbol{w}$:= 0. t:= t↑($\mathcal{T}_{\boldsymbol{r}}$ + 1). $\boldsymbol{r}$:= $\boldsymbol{r}$+1.

$\mathcal{M}_{\boldsymbol{w}}$ = 5 ∧ $\mathcal{T}_{\boldsymbol{w}}$ = t ∧ $\boldsymbol{r}'$=$\boldsymbol{r}$ ∧ $\boldsymbol{w}'$ = $\boldsymbol{w}$+1 ∧ t'=t

Deadlock

$\textbf{chan } c\text{: } int \cdot \; t := t \uparrow (\mathcal{T}_{\boldsymbol{r}} + 1).\; c?.\; c!\, 5$

$= \quad \exists \mathcal{M}\text{: } \infty{*}int \cdot \exists \mathcal{T}\text{: } \infty{*}xnat \cdot \textbf{ var } \boldsymbol{r}, \boldsymbol{w}\text{: } xnat := 0 \cdot$

$t := t \uparrow (\mathcal{T}_{\boldsymbol{r}} + 1).\; \boldsymbol{r} := \boldsymbol{r}+1.\; \mathcal{M}_{\boldsymbol{w}} = 5 \;\wedge\; \mathcal{T}_{\boldsymbol{w}} = t \;\wedge\; (\boldsymbol{w} := \boldsymbol{w}+1)$

$= \quad \exists \mathcal{M}\text{: } \infty{*}int \cdot \exists \mathcal{T}\text{: } \infty{*}xnat \cdot \exists \boldsymbol{r}, \boldsymbol{r}', \boldsymbol{w}, \boldsymbol{w}'\text{: } xnat \cdot$

$\boldsymbol{r} := 0.\; \boldsymbol{w} := 0.\; t := t \uparrow (\mathcal{T}_{\boldsymbol{r}} + 1).\; \boldsymbol{r} := \boldsymbol{r}+1.$

$\mathcal{M}_{\boldsymbol{w}} = 5 \;\wedge\; \mathcal{T}_{\boldsymbol{w}} = t \;\wedge\; \boldsymbol{r}' = \boldsymbol{r} \;\wedge\; \boldsymbol{w}' = \boldsymbol{w}+1 \;\wedge\; t' = t$

$= \quad \exists \mathcal{M}\text{: } \infty{*}int \cdot \exists \mathcal{T}\text{: } \infty{*}xnat \cdot \exists \boldsymbol{r}, \boldsymbol{r}', \boldsymbol{w}, \boldsymbol{w}'\text{: } xnat \cdot$

$\mathcal{M}_0 = 5 \;\wedge\; \mathcal{T}_0 = t \uparrow (\mathcal{T}_0 + 1) \;\wedge\; \boldsymbol{r}' = 1 \;\wedge\; \boldsymbol{w}' = 1 \;\wedge\; t' = t \uparrow (\mathcal{T}_0 + 1)$

Deadlock

$\textbf{chan } c\text{: } int\cdot\ \ t\text{:= } t\uparrow(\mathcal{T}_{\boldsymbol{r}} + 1).\ \ c?.\ \ c!\ 5$

$=\quad \exists\mathcal{M}\text{: } \infty{*}int\cdot\ \exists\mathcal{T}\text{: } \infty{*}xnat\cdot\ \textbf{var } \boldsymbol{r}, \boldsymbol{w}\text{: } xnat := 0\cdot$

$t\text{:= } t\uparrow(\mathcal{T}_{\boldsymbol{r}} + 1).\ \ \boldsymbol{r}\text{:= } \boldsymbol{r}{+}1.\ \ \mathcal{M}_{\boldsymbol{w}} = 5\ \ \wedge\ \ \mathcal{T}_{\boldsymbol{w}} = t\ \ \wedge\ \ (\boldsymbol{w}\text{:= } \boldsymbol{w}{+}1)$

$=\quad \exists\mathcal{M}\text{: } \infty{*}int\cdot\ \exists\mathcal{T}\text{: } \infty{*}xnat\cdot\ \exists\boldsymbol{r}, \boldsymbol{r}', \boldsymbol{w}, \boldsymbol{w}'\text{: } xnat\cdot$

$\boldsymbol{r}\text{:= } 0.\ \ \boldsymbol{w}\text{:= } 0.\ \ t\text{:= } t\uparrow(\mathcal{T}_{\boldsymbol{r}} + 1).\ \ \boldsymbol{r}\text{:= } \boldsymbol{r}{+}1.$

$\mathcal{M}_{\boldsymbol{w}} = 5\ \ \wedge\ \ \mathcal{T}_{\boldsymbol{w}} = t\ \ \wedge\ \ \boldsymbol{r}'{=}\boldsymbol{r}\ \ \wedge\ \ \boldsymbol{w}' = \boldsymbol{w}{+}1\ \ \wedge\ \ t'{=}t$

$=\quad \exists\mathcal{M}\text{: } \infty{*}int\cdot\ \exists\mathcal{T}\text{: } \infty{*}xnat\cdot\ \exists\boldsymbol{r}, \boldsymbol{r}', \boldsymbol{w}, \boldsymbol{w}'\text{: } xnat\cdot$

$\mathcal{M}_0 = 5\ \ \wedge\ \ \mathcal{T}_0 = t\uparrow(\mathcal{T}_0 + 1)\ \ \wedge\ \ \boldsymbol{r}'{=}1\ \ \wedge\ \ \boldsymbol{w}'{=}1\ \ \wedge\ \ t' = t\uparrow(\mathcal{T}_0 + 1)$

Deadlock

$\textbf{chan } c\text{: } int\cdot\ \ t := t\uparrow(\mathcal{T}_{\boldsymbol{r}} + 1).\ \ c?.\ \ c!\ 5$

$=\quad \exists \mathcal{M}\text{: } \infty{*}int\cdot\ \exists \mathcal{T}\text{: } \infty{*}xnat\cdot\ \textbf{var } \boldsymbol{r}, \boldsymbol{w}\text{: } xnat := 0\cdot$

$t := t\uparrow(\mathcal{T}_{\boldsymbol{r}} + 1).\ \ \boldsymbol{r} := \boldsymbol{r}{+}1.\ \ \mathcal{M}_{\boldsymbol{w}} = 5\ \wedge\ \mathcal{T}_{\boldsymbol{w}} = t\ \wedge\ (\boldsymbol{w} := \boldsymbol{w}{+}1)$

$=\quad \exists \mathcal{M}\text{: } \infty{*}int\cdot\ \exists \mathcal{T}\text{: } \infty{*}xnat\cdot\ \exists \boldsymbol{r}, \boldsymbol{r}', \boldsymbol{w}, \boldsymbol{w}'\text{: } xnat\cdot$

$\boldsymbol{r} := 0.\ \ \boldsymbol{w} := 0.\ \ t := t\uparrow(\mathcal{T}_{\boldsymbol{r}} + 1).\ \ \boldsymbol{r} := \boldsymbol{r}{+}1.$

$\mathcal{M}_{\boldsymbol{w}} = 5\ \wedge\ \mathcal{T}_{\boldsymbol{w}} = t\ \wedge\ \boldsymbol{r}' {=} \boldsymbol{r}\ \wedge\ \boldsymbol{w}' = \boldsymbol{w}{+}1\ \wedge\ t' {=} t$

$=\quad \exists \mathcal{M}\text{: } \infty{*}int\cdot\ \exists \mathcal{T}\text{: } \infty{*}xnat\cdot\ \exists \boldsymbol{r}, \boldsymbol{r}', \boldsymbol{w}, \boldsymbol{w}'\text{: } xnat\cdot$

$\mathcal{M}_0 = 5\ \wedge\ \mathcal{T}_0 = t\uparrow(\mathcal{T}_0 + 1)\ \wedge\ \boldsymbol{r}' {=} 1\ \wedge\ \boldsymbol{w}' {=} 1\ \wedge\ t' = t\uparrow(\mathcal{T}_0 + 1)$

Deadlock

$\textbf{chan } c: int\cdot\ \ t := t\uparrow(\mathcal{T}_{\boldsymbol{r}} + 1).\ \ c?.\ \ c!\ 5$

$=\quad \exists \mathcal{M}: \infty{*}int\cdot\ \exists \mathcal{T}: \infty{*}xnat\cdot\ \textbf{var } \boldsymbol{r}, \boldsymbol{w}: xnat := 0\cdot$

$t := t\uparrow(\mathcal{T}_{\boldsymbol{r}} + 1).\ \ \boldsymbol{r} := \boldsymbol{r}+1.\ \ \mathcal{M}_{\boldsymbol{w}} = 5\ \land\ \mathcal{T}_{\boldsymbol{w}} = t\ \land\ (\boldsymbol{w} := \boldsymbol{w}+1)$

$=\quad \exists \mathcal{M}: \infty{*}int\cdot\ \exists \mathcal{T}: \infty{*}xnat\cdot\ \exists \boldsymbol{r}, \boldsymbol{r}', \boldsymbol{w}, \boldsymbol{w}': xnat\cdot$

$\boldsymbol{r} := 0.\ \ \boldsymbol{w} := 0.\ \ t := t\uparrow(\mathcal{T}_{\boldsymbol{r}} + 1).\ \ \boldsymbol{r} := \boldsymbol{r}+1.$

$\mathcal{M}_{\boldsymbol{w}} = 5\ \land\ \mathcal{T}_{\boldsymbol{w}} = t\ \land\ \boldsymbol{r}'=\boldsymbol{r}\ \land\ \boldsymbol{w}' = \boldsymbol{w}+1\ \land\ t'=t$

$=\quad \exists \mathcal{M}: \infty{*}int\cdot\ \exists \mathcal{T}: \infty{*}xnat\cdot\ \exists \boldsymbol{r}, \boldsymbol{r}', \boldsymbol{w}, \boldsymbol{w}': xnat\cdot$

$\mathcal{M}_0 = 5\ \land\ \mathcal{T}_0 = t\uparrow(\mathcal{T}_0 + 1)\ \land\ \boldsymbol{r}'=1\ \land\ \boldsymbol{w}'=1\ \land\ t' = t\uparrow(\mathcal{T}_0 + 1)$

$=\quad t'=\infty$

Deadlock

$\textbf{chan } c, d\colon int \cdot\ (c?.\ d!\,6) \parallel (d?.\ c!\,7)$

Deadlock

chan c, d: $int\cdot$ $(c?.\ d!\ 6)\ \|\ (d?.\ c!\ 7)$

chan c, d: $int\cdot$ $(t{:=}\ t\uparrow(\mathcal{T}c_{\boldsymbol{r}c} + 1).\ c?.\ d!\ 6)\ \|\ (t{:=}\ t\uparrow(\mathcal{T}d_{\boldsymbol{r}d} + 1).\ d?.\ c!\ 7)$

Deadlock

$$\textbf{chan } c, d: int \cdot\ (c?.\ d!\ 6)\ \|\ (d?.\ c!\ 7)$$

$$\textbf{chan } c, d: int \cdot\ (t := t \uparrow (\mathcal{T}c_{\boldsymbol{r}c} + 1).\ c?.\ d!\ 6)\ \|\ (t := t \uparrow (\mathcal{T}d_{\boldsymbol{r}d} + 1).\ d?.\ c!\ 7)$$

$$= \quad \exists \mathcal{M}c, \mathcal{M}d: \infty^* int \cdot \exists \mathcal{T}c, \mathcal{T}d: \infty^* xnat \cdot \exists \boldsymbol{r}c, \boldsymbol{r}c', \boldsymbol{w}c, \boldsymbol{w}c', \boldsymbol{r}d, \boldsymbol{r}d', \boldsymbol{w}d, \boldsymbol{w}d': xnat \cdot$$

$$\mathcal{M}d_0 = 6\ \wedge\ \mathcal{M}c_0 = 7\ \wedge\ \boldsymbol{r}c' = \boldsymbol{w}c' = \boldsymbol{r}d' = \boldsymbol{w}d' = 1$$

$$\wedge \quad \mathcal{T}c_0 = t \uparrow (\mathcal{T}d_0 + 1)\ \wedge\ \mathcal{T}d_0 = t \uparrow (\mathcal{T}c_0 + 1)$$

$$\wedge \quad t' = t \uparrow (\mathcal{T}d_0 + 1) \uparrow (\mathcal{T}c_0 + 1)$$

Deadlock

chan $c, d: int \cdot\ (c?.\ d!\ 6)\ \|\ (d?.\ c!\ 7)$

chan $c, d: int \cdot\ (t{:=}\ t\uparrow(\mathcal{T}c_{\boldsymbol{r}c} + 1).\ c?.\ d!\ 6)\ \|\ (t{:=}\ t\uparrow(\mathcal{T}d_{\boldsymbol{r}d} + 1).\ d?.\ c!\ 7)$

$=\quad \exists \mathcal{M}c, \mathcal{M}d: \infty^*int\cdot\ \exists \mathcal{T}c, \mathcal{T}d: \infty^*xnat\cdot\ \exists \boldsymbol{r}c, \boldsymbol{r}c', \boldsymbol{w}c, \boldsymbol{w}c', \boldsymbol{r}d, \boldsymbol{r}d', \boldsymbol{w}d, \boldsymbol{w}d': xnat\cdot$

$\mathcal{M}d_0 = 6\ \wedge\ \mathcal{M}c_0 = 7\ \wedge\ \boldsymbol{r}c' = \boldsymbol{w}c' = \boldsymbol{r}d' = \boldsymbol{w}d' = 1$

$\wedge\quad \mathcal{T}c_0 = t\uparrow(\mathcal{T}d_0 + 1)\ \wedge\ \mathcal{T}d_0 = t\uparrow(\mathcal{T}c_0 + 1)$ ⟵

$\wedge\quad t' = t\uparrow(\mathcal{T}d_0 + 1)\uparrow(\mathcal{T}c_0 + 1)$

Deadlock

$\textbf{chan}\ c, d{:}\ int\cdot\ \ (c?.\ \ d!\ 6)\ \|\ (d?.\ \ c!\ 7)$

$\textbf{chan}\ c, d{:}\ int\cdot\ \ (t{:=}\ t\uparrow(\mathcal{T}c_{\boldsymbol{r}c} + 1).\ \ c?.\ \ d!\ 6)\ \|\ (t{:=}\ t\uparrow(\mathcal{T}d_{\boldsymbol{r}d} + 1).\ \ d?.\ \ c!\ 7)$

$$\begin{aligned}
= \quad & \exists \mathcal{M}c, \mathcal{M}d{:}\ \infty{*}int\cdot\ \exists \mathcal{T}c, \mathcal{T}d{:}\ \infty{*}xnat\cdot\ \exists \boldsymbol{r}c, \boldsymbol{r}c', \boldsymbol{w}c, \boldsymbol{w}c', \boldsymbol{r}d, \boldsymbol{r}d', \boldsymbol{w}d, \boldsymbol{w}d'{:}\ xnat\cdot \\
& \qquad \mathcal{M}d_0 = 6\ \wedge\ \mathcal{M}c_0 = 7\ \wedge\ \boldsymbol{r}c' = \boldsymbol{w}c' = \boldsymbol{r}d' = \boldsymbol{w}d' = 1 \\
& \wedge \qquad \mathcal{T}c_0 = t\uparrow(\mathcal{T}d_0 + 1)\ \wedge\ \mathcal{T}d_0 = t\uparrow(\mathcal{T}c_0 + 1) \\
& \wedge \qquad t' = t\uparrow(\mathcal{T}d_0 + 1)\uparrow(\mathcal{T}c_0 + 1) \quad \longleftarrow
\end{aligned}$$

Deadlock

$\textbf{chan}\ c, d: int\cdot\ (c?.\ d!\ 6)\ \|\ (d?.\ c!\ 7)$

$\textbf{chan}\ c, d: int\cdot\ (t{:=}\ t\uparrow(\mathcal{T}c_{\boldsymbol{r}c} + 1).\ c?.\ d!\ 6)\ \|\ (t{:=}\ t\uparrow(\mathcal{T}d_{\boldsymbol{r}d} + 1).\ d?.\ c!\ 7)$

$=\quad \exists\mathcal{M}c, \mathcal{M}d: \infty{*}int\cdot\ \exists\mathcal{T}c, \mathcal{T}d: \infty{*}xnat\cdot\ \exists\boldsymbol{r}c, \boldsymbol{r}c', \boldsymbol{w}c, \boldsymbol{w}c', \boldsymbol{r}d, \boldsymbol{r}d', \boldsymbol{w}d, \boldsymbol{w}d': xnat\cdot$

$\mathcal{M}d_0 = 6\ \land\ \mathcal{M}c_0 = 7\ \land\ \boldsymbol{r}c' = \boldsymbol{w}c' = \boldsymbol{r}d' = \boldsymbol{w}d' = 1$

$\land\quad \mathcal{T}c_0 = t\uparrow(\mathcal{T}d_0 + 1)\ \land\ \mathcal{T}d_0 = t\uparrow(\mathcal{T}c_0 + 1)$

$\land\quad t' = t\uparrow(\mathcal{T}d_0 + 1)\uparrow(\mathcal{T}c_0 + 1)$

$=\quad t'{=}\infty$

Power Series Multiplication

Power Series Multiplication

Input on channel a : $a_0\ a_1\ a_2$ ...

Power Series Multiplication

Input on channel a : $a_0\ a_1\ a_2$ ... $A = a_0 + a_1 \times x + a_2 \times x^2 + ...$

Power Series Multiplication

Input on channel a : $a_0\ a_1\ a_2$ ...

$A = a_0 + a_1 \times x + a_2 \times x^2 + ...$

Input on channel b : $b_0\ b_1\ b_2$ ...

Power Series Multiplication

Input on channel a : $a_0\ a_1\ a_2\ ...$ $\qquad A = a_0 + a_1 \times x + a_2 \times x^2 + ...$

Input on channel b : $b_0\ b_1\ b_2\ ...$ $\qquad B = b_0 + b_1 \times x + b_2 \times x^2 + ...$

Power Series Multiplication

Input on channel a : $a_0\ a_1\ a_2$ ...

Input on channel b : $b_0\ b_1\ b_2$ ...

Output on channel c : $c_0\ c_1\ c_2$ ...

$A = a_0 + a_1 \times x + a_2 \times x^2 + ...$

$B = b_0 + b_1 \times x + b_2 \times x^2 + ...$

Power Series Multiplication

Input on channel a : $a_0\ a_1\ a_2$ ... $\quad A = a_0 + a_1 \times x + a_2 \times x^2 + \ldots$

Input on channel b : $b_0\ b_1\ b_2$ ... $\quad B = b_0 + b_1 \times x + b_2 \times x^2 + \ldots$

Output on channel c : $c_0\ c_1\ c_2$ ... $\quad C = c_0 + c_1 \times x + c_2 \times x^2 + \ldots$

Power Series Multiplication

Input on channel a : $a_0\ a_1\ a_2\ ...$ $\quad A = a_0 + a_1 \times x + a_2 \times x^2 + ...$

Input on channel b : $b_0\ b_1\ b_2\ ...$ $\quad B = b_0 + b_1 \times x + b_2 \times x^2 + ...$

Output on channel c : $c_0\ c_1\ c_2\ ...$ $\quad C = c_0 + c_1 \times x + c_2 \times x^2 + ...$

$$C = A \times B$$

Power Series Multiplication

Input on channel a : $a_0\ a_1\ a_2\ \ldots$

Input on channel b : $b_0\ b_1\ b_2\ \ldots$

Output on channel c : $c_0\ c_1\ c_2\ \ldots$

$A = a_0 + a_1 \times x + a_2 \times x^2 + \ldots$

$B = b_0 + b_1 \times x + b_2 \times x^2 + \ldots$

$C = c_0 + c_1 \times x + c_2 \times x^2 + \ldots$

$$C = A \times B = a_0 \times b_0 + (a_0 \times b_1 + a_1 \times b_0)x + (a_0 \times b_2 + a_1 \times b_1 + a_2 \times b_0) \times x^2 + \ldots$$

Power Series Multiplication

Input on channel a : $a_0\ a_1\ a_2$ ... $\quad A = a_0 + a_1 \times x + a_2 \times x^2 + \ldots$

Input on channel b : $b_0\ b_1\ b_2$ ... $\quad B = b_0 + b_1 \times x + b_2 \times x^2 + \ldots$

Output on channel c : $c_0\ c_1\ c_2$ ... $\quad C = c_0 + c_1 \times x + c_2 \times x^2 + \ldots$

$A_1 = a_1 + a_2 \times x + a_3 \times x^2 + \ldots \qquad B_1 = b_1 + b_2 \times x + b_3 \times x^2 + \ldots$

$A_2 = a_2 + a_3 \times x + a_4 \times x^2 + \ldots \qquad B_2 = b_2 + b_3 \times x + b_4 \times x^2 + \ldots$

$$C = A \times B = a_0 \times b_0 + (a_0 \times b_1 + a_1 \times b_0)x + (a_0 \times b_2 + a_1 \times b_1 + a_2 \times b_0) \times x^2 + \ldots$$

Power Series Multiplication

Input on channel a : $a_0\ a_1\ a_2\ ...$

Input on channel b : $b_0\ b_1\ b_2\ ...$

Output on channel c : $c_0\ c_1\ c_2\ ...$

$A = a_0 + a_1 \times x + a_2 \times x^2 + ...$

$B = b_0 + b_1 \times x + b_2 \times x^2 + ...$

$C = c_0 + c_1 \times x + c_2 \times x^2 + ...$

$A_1 = a_1 + a_2 \times x + a_3 \times x^2 + ...$

$A_2 = a_2 + a_3 \times x + a_4 \times x^2 + ...$

$B_1 = b_1 + b_2 \times x + b_3 \times x^2 + ...$

$B_2 = b_2 + b_3 \times x + b_4 \times x^2 + ...$

$$C = A \times B = a_0 \times b_0 + (a_0 \times b_1 + a_1 \times b_0)x + (a_0 \times b_2 + a_1 \times b_1 + a_2 \times b_0) \times x^2 + ...$$

Power Series Multiplication

Input on channel a : $a_0\ a_1\ a_2\ \ldots$

Input on channel b : $b_0\ b_1\ b_2\ \ldots$

Output on channel c : $c_0\ c_1\ c_2\ \ldots$

$A = a_0 + a_1 \times x + a_2 \times x^2 + \ldots$

$B = b_0 + b_1 \times x + b_2 \times x^2 + \ldots$

$C = c_0 + c_1 \times x + c_2 \times x^2 + \ldots$

$A_1 = a_1 + a_2 \times x + a_3 \times x^2 + \ldots$

$A_2 = a_2 + a_3 \times x + a_4 \times x^2 + \ldots$

$B_1 = b_1 + b_2 \times x + b_3 \times x^2 + \ldots$

$B_2 = b_2 + b_3 \times x + b_4 \times x^2 + \ldots$

$$C = A \times B = a_0 \times b_0 + (a_0 \times b_1 + a_1 \times b_0)x + (a_0 \times b_2 + a_1 \times b_1 + a_2 \times b_0) \times x^2 + \ldots$$

Power Series Multiplication

Input on channel a : $a_0\ a_1\ a_2\ ...$

Input on channel b : $b_0\ b_1\ b_2\ ...$

Output on channel c : $c_0\ c_1\ c_2\ ...$

$$A = a_0 + a_1{\times}x + a_2{\times}x^2 + ...$$

$$B = b_0 + b_1{\times}x + b_2{\times}x^2 + ...$$

$$C = c_0 + c_1{\times}x + c_2{\times}x^2 + ...$$

$$A_1 = a_1 + a_2{\times}x + a_3{\times}x^2 + ...$$

$$A_2 = a_2 + a_3{\times}x + a_4{\times}x^2 + ...$$

$$B_1 = b_1 + b_2{\times}x + b_3{\times}x^2 + ...$$

$$B_2 = b_2 + b_3{\times}x + b_4{\times}x^2 + ...$$

$$C = A \times B = a_0{\times}b_0 + (a_0{\times}b_1 + a_1{\times}b_0)x + (a_0{\times}B_2 + A_1{\times}B_1 + A_2{\times}b_0){\times}x^2$$

Power Series Multiplication

Input on channel a : $a_0\ a_1\ a_2$ ...

Input on channel b : $b_0\ b_1\ b_2$ ...

Output on channel c : $c_0\ c_1\ c_2$ ...

$A = a_0 + a_1 \times x + a_2 \times x^2 + \ldots$

$B = b_0 + b_1 \times x + b_2 \times x^2 + \ldots$

$C = c_0 + c_1 \times x + c_2 \times x^2 + \ldots$

$A_1 = a_1 + a_2 \times x + a_3 \times x^2 + \ldots$

$A_2 = a_2 + a_3 \times x + a_4 \times x^2 + \ldots$

$B_1 = b_1 + b_2 \times x + b_3 \times x^2 + \ldots$

$B_2 = b_2 + b_3 \times x + b_4 \times x^2 + \ldots$

$$C = A \times B = a_0 \times b_0 + (a_0 \times b_1 + a_1 \times b_0)x + (a_0 \times B_2 + A_1 \times B_1 + A_2 \times b_0) \times x^2$$

$$\uparrow \qquad \qquad \uparrow$$

Power Series Multiplication

Input on channel a : $a_0\ a_1\ a_2$ ...

Input on channel b : $b_0\ b_1\ b_2$ ...

Output on channel c : $c_0\ c_1\ c_2$ ...

$A = a_0 + a_1{\times}x + a_2{\times}x^2 + \ldots$

$B = b_0 + b_1{\times}x + b_2{\times}x^2 + \ldots$

$C = c_0 + c_1{\times}x + c_2{\times}x^2 + \ldots$

$A_1 = a_1 + a_2{\times}x + a_3{\times}x^2 + \ldots$

$A_2 = a_2 + a_3{\times}x + a_4{\times}x^2 + \ldots$

$B_1 = b_1 + b_2{\times}x + b_3{\times}x^2 + \ldots$

$B_2 = b_2 + b_3{\times}x + b_4{\times}x^2 + \ldots$

$$C = A \times B = a_0{\times}b_0 + (a_0{\times}b_1 + a_1{\times}b_0)x + (a_0{\times}B_2 + A_1{\times}B_1 + A_2{\times}b_0){\times}x^2$$

↑

Power Series Multiplication

Input on channel a : $a_0\ a_1\ a_2\ ...$

Input on channel b : $b_0\ b_1\ b_2\ ...$

Output on channel c : $c_0\ c_1\ c_2\ ...$

$A = a_0 + a_1{\times}x + a_2{\times}x^2 + ...$

$B = b_0 + b_1{\times}x + b_2{\times}x^2 + ...$

$C = c_0 + c_1{\times}x + c_2{\times}x^2 + ...$

$A_1 = a_1 + a_2{\times}x + a_3{\times}x^2 + ...$

$A_2 = a_2 + a_3{\times}x + a_4{\times}x^2 + ...$

$B_1 = b_1 + b_2{\times}x + b_3{\times}x^2 + ...$

$B_2 = b_2 + b_3{\times}x + b_4{\times}x^2 + ...$

$$C = A \times B = a_0{\times}b_0 + (a_0{\times}b_1 + a_1{\times}b_0)x + (a_0{\times}B_2 + A_1{\times}B_1 + A_2{\times}b_0){\times}x^2$$

$C = A{\times}B$

Power Series Multiplication

Input on channel a : $a_0\ a_1\ a_2\ ...$ $\qquad A\ =\ a_0 + a_1{\times}x + a_2{\times}x^2 + ...$

Input on channel b : $b_0\ b_1\ b_2\ ...$ $\qquad B\ =\ b_0 + b_1{\times}x + b_2{\times}x^2 + ...$

Output on channel c : $c_0\ c_1\ c_2\ ...$ $\qquad C\ =\ c_0 + c_1{\times}x + c_2{\times}x^2 + ...$

$A_1\ =\ a_1 + a_2{\times}x + a_3{\times}x^2 + ...$ $\qquad B_1\ =\ b_1 + b_2{\times}x + b_3{\times}x^2 + ...$

$A_2\ =\ a_2 + a_3{\times}x + a_4{\times}x^2 + ...$ $\qquad B_2\ =\ b_2 + b_3{\times}x + b_4{\times}x^2 + ...$

$$C\ =\ A \times B\ =\ a_0{\times}b_0 + (a_0{\times}b_1 + a_1{\times}b_0)x + (a_0{\times}B_2 + A_1{\times}B_1 + A_2{\times}b_0){\times}x^2$$

$\langle$**chan** c: $rat\cdot\ \ C = A{\times}B\rangle$

Power Series Multiplication

Input on channel a : $a_0\ a_1\ a_2$ ...

$A = a_0 + a_1{\times}x + a_2{\times}x^2 + ...$

Input on channel b : $b_0\ b_1\ b_2$ ...

$B = b_0 + b_1{\times}x + b_2{\times}x^2 + ...$

Output on channel c : $c_0\ c_1\ c_2$ ...

$C = c_0 + c_1{\times}x + c_2{\times}x^2 + ...$

$A_1 = a_1 + a_2{\times}x + a_3{\times}x^2 + ...$

$B_1 = b_1 + b_2{\times}x + b_3{\times}x^2 + ...$

$A_2 = a_2 + a_3{\times}x + a_4{\times}x^2 + ...$

$B_2 = b_2 + b_3{\times}x + b_4{\times}x^2 + ...$

$$C = A \times B = a_0{\times}b_0 + (a_0{\times}b_1 + a_1{\times}b_0)x + (a_0{\times}B_2 + A_1{\times}B_1 + A_2{\times}b_0){\times}x^2$$

$\langle$**chan** c: $rat\cdot\ \ C = A{\times}B\rangle\ c$

Power Series Multiplication

Input on channel a : $a_0\ a_1\ a_2$ ...

Input on channel b : $b_0\ b_1\ b_2$ ...

Output on channel c : $c_0\ c_1\ c_2$ ...

$A = a_0 + a_1{\times}x + a_2{\times}x^2 + \ldots$

$B = b_0 + b_1{\times}x + b_2{\times}x^2 + \ldots$

$C = c_0 + c_1{\times}x + c_2{\times}x^2 + \ldots$

$A_1 = a_1 + a_2{\times}x + a_3{\times}x^2 + \ldots$

$A_2 = a_2 + a_3{\times}x + a_4{\times}x^2 + \ldots$

$B_1 = b_1 + b_2{\times}x + b_3{\times}x^2 + \ldots$

$B_2 = b_2 + b_3{\times}x + b_4{\times}x^2 + \ldots$

$$C = A \times B = a_0{\times}b_0 + (a_0{\times}b_1 + a_1{\times}b_0)x + (a_0{\times}B_2 + A_1{\times}B_1 + A_2{\times}b_0){\times}x^2$$

$\langle \mathbf{chan}\ c{:}\ rat\cdot\ \ C = A{\times}B\rangle\ c \quad \Leftarrow \quad (a?\ \|\ b?).\ \ c!\ a{\times}b.$

$\mathbf{var}\ a0{:}\ rat := a\cdot\ \ \mathbf{var}\ b0{:}\ rat := b\cdot\ \ \mathbf{chan}\ d{:}\ rat\cdot$

$\quad \langle \mathbf{chan}\ c{:}\ rat \rightarrow C = A{\times}B\rangle\ d$

$\|\quad ((a?\ \|\ b?).\ \ c!\ a0{\times}b + a{\times}b0.\ \ C = a0{\times}B + D + A{\times}b0)$

$C = a0{\times}B + D + A{\times}b0 \quad \Leftarrow \quad (a?\ \|\ b?\ \|\ d?).\ \ c!\ a0{\times}b + d + a{\times}b0.\ \ C = a0{\times}B + D + A{\times}b0$

Power Series Multiplication

Input on channel a : $a_0\ a_1\ a_2$ ... $\quad A = a_0 + a_1{\times}x + a_2{\times}x^2 + ...$

Input on channel b : $b_0\ b_1\ b_2$ ... $\quad B = b_0 + b_1{\times}x + b_2{\times}x^2 + ...$

Output on channel c : $c_0\ c_1\ c_2$ ... $\quad C = c_0 + c_1{\times}x + c_2{\times}x^2 + ...$

$A_1 = a_1 + a_2{\times}x + a_3{\times}x^2 + ...$ $\quad B_1 = b_1 + b_2{\times}x + b_3{\times}x^2 + ...$

$A_2 = a_2 + a_3{\times}x + a_4{\times}x^2 + ...$ $\quad B_2 = b_2 + b_3{\times}x + b_4{\times}x^2 + ...$

$$C = A \times B = a_0{\times}b_0 + (a_0{\times}b_1 + a_1{\times}b_0)x + (a_0{\times}B_2 + A_1{\times}B_1 + A_2{\times}b_0){\times}x^2$$

$$\langle \mathbf{chan}\ c{:}\ rat\cdot\ C = A{\times}B\rangle\ c \quad \Leftarrow \quad (a? \,\|\, b?).\ c!\ a{\times}b.$$

$$\mathbf{var}\ a0{:}\ rat := a\cdot\ \ \mathbf{var}\ b0{:}\ rat := b\cdot\ \ \mathbf{chan}\ d{:}\ rat\cdot$$

$$\langle \mathbf{chan}\ c{:}\ rat \rightarrow C = A{\times}B\rangle\ d$$

$$\|\ \ ((a? \,\|\, b?).\ c!\ a0{\times}b + a{\times}b0.\ C = a0{\times}B + D + A{\times}b0)$$

$$C = a0{\times}B + D + A{\times}b0 \quad \Leftarrow \quad (a? \,\|\, b? \,\|\, d?).\ c!\ a0{\times}b + d + a{\times}b0.\ C = a0{\times}B + D + A{\times}b0$$

Power Series Multiplication

Input on channel a : $a_0\ a_1\ a_2$ ... $A = a_0 + a_1 \times x + a_2 \times x^2 + ...$

Input on channel b : $b_0\ b_1\ b_2$ ... $B = b_0 + b_1 \times x + b_2 \times x^2 + ...$

Output on channel c : $c_0\ c_1\ c_2$ ... $C = c_0 + c_1 \times x + c_2 \times x^2 + ...$

$A_1 = a_1 + a_2 \times x + a_3 \times x^2 + ...$ $B_1 = b_1 + b_2 \times x + b_3 \times x^2 + ...$

$A_2 = a_2 + a_3 \times x + a_4 \times x^2 + ...$ $B_2 = b_2 + b_3 \times x + b_4 \times x^2 + ...$

$$C = A \times B = a_0 \times b_0 + (a_0 \times b_1 + a_1 \times b_0)x + (a_0 \times B_2 + A_1 \times B_1 + A_2 \times b_0) \times x^2$$

$\langle$**chan** c: $rat \cdot$ $C = A \times B\rangle$ c $\Leftarrow$ $(a? \,\|\, b?).$ $c!$ $a \times b.$

var $a0$: $rat := a \cdot$ **var** $b0$: $rat := b \cdot$ **chan** d: $rat \cdot$

$\langle$**chan** c: $rat \rightarrow C = A \times B\rangle$ d

$\|$ $((a? \,\|\, b?).$ $c!$ $a0 \times b + a \times b0.$ $C = a0 \times B + D + A \times b0)$

$C = a0 \times B + D + A \times b0$ $\Leftarrow$ $(a? \,\|\, b? \,\|\, d?).$ $c!$ $a0 \times b + d + a \times b0.$ $C = a0 \times B + D + A \times b0$

Power Series Multiplication

Input on channel a : $a_0\ a_1\ a_2$ ... $A = a_0 + a_1{\times}x + a_2{\times}x^2 + ...$

Input on channel b : $b_0\ b_1\ b_2$ ... $B = b_0 + b_1{\times}x + b_2{\times}x^2 + ...$

Output on channel c : $c_0\ c_1\ c_2$ ... $C = c_0 + c_1{\times}x + c_2{\times}x^2 + ...$

$A_1 = a_1 + a_2{\times}x + a_3{\times}x^2 + ...$ $B_1 = b_1 + b_2{\times}x + b_3{\times}x^2 + ...$

$A_2 = a_2 + a_3{\times}x + a_4{\times}x^2 + ...$ $B_2 = b_2 + b_3{\times}x + b_4{\times}x^2 + ...$

$$C = A \times B = a_0{\times}b_0 + (a_0{\times}b_1 + a_1{\times}b_0)x + (a_0{\times}B_2 + A_1{\times}B_1 + A_2{\times}b_0){\times}x^2$$

$\langle \textbf{chan}\ c{:}\ rat\cdot\ \ C = A{\times}B\rangle\ c \quad \Leftarrow \quad (a? \parallel b?).\ \ c!\ a{\times}b.$

$\longrightarrow \quad \textbf{var}\ a0{:}\ rat := a\cdot\ \ \textbf{var}\ b0{:}\ rat := b\cdot\ \ \textbf{chan}\ d{:}\ rat\cdot$

$\quad \langle \textbf{chan}\ c{:}\ rat \rightarrow C = A{\times}B\rangle\ d$

$\parallel \quad ((a? \parallel b?).\ \ c!\ a0{\times}b + a{\times}b0.\ \ C = a0{\times}B + D + A{\times}b0)$

$C = a0{\times}B + D + A{\times}b0 \quad \Leftarrow \quad (a? \parallel b? \parallel d?).\ \ c!\ a0{\times}b + d + a{\times}b0.\ \ C = a0{\times}B + D + A{\times}b0$

Power Series Multiplication

Input on channel a : $a_0\ a_1\ a_2$ ... $\quad A = a_0 + a_1{\times}x + a_2{\times}x^2 + ...$

Input on channel b : $b_0\ b_1\ b_2$ ... $\quad B = b_0 + b_1{\times}x + b_2{\times}x^2 + ...$

Output on channel c : $c_0\ c_1\ c_2$ ... $\quad C = c_0 + c_1{\times}x + c_2{\times}x^2 + ...$

$A_1 = a_1 + a_2{\times}x + a_3{\times}x^2 + ...$ $\quad B_1 = b_1 + b_2{\times}x + b_3{\times}x^2 + ...$

$A_2 = a_2 + a_3{\times}x + a_4{\times}x^2 + ...$ $\quad B_2 = b_2 + b_3{\times}x + b_4{\times}x^2 + ...$

$$C = A \times B = a_0{\times}b_0 + (a_0{\times}b_1 + a_1{\times}b_0)x + (a_0{\times}B_2 + A_1{\times}B_1 + A_2{\times}b_0){\times}x^2$$

$\langle$**chan** c: $rat\cdot\ C = A{\times}B\rangle\ c \quad \Leftarrow \quad (a? \,\|\, b?).\ c!\ a{\times}b.$

var $a0$: $rat := a\cdot$ **var** $b0$: $rat := b\cdot$ **chan** d: $rat\cdot$

$\longrightarrow$ $\langle$**chan** c: $rat \rightarrow C = A{\times}B\rangle\ d$

$\|\ ((a? \,\|\, b?).\ c!\ a0{\times}b + a{\times}b0.\ C = a0{\times}B + D + A{\times}b0)$

$C = a0{\times}B + D + A{\times}b0 \quad \Leftarrow \quad (a? \,\|\, b? \,\|\, d?).\ c!\ a0{\times}b + d + a{\times}b0.\ C = a0{\times}B + D + A{\times}b0$

Power Series Multiplication

Input on channel a : $a_0\ a_1\ a_2$ ... $\quad A = a_0 + a_1{\times}x + a_2{\times}x^2 + ...$

Input on channel b : $b_0\ b_1\ b_2$ ... $\quad B = b_0 + b_1{\times}x + b_2{\times}x^2 + ...$

Output on channel c : $c_0\ c_1\ c_2$ ... $\quad C = c_0 + c_1{\times}x + c_2{\times}x^2 + ...$

$A_1 = a_1 + a_2{\times}x + a_3{\times}x^2 + ...$ $\quad B_1 = b_1 + b_2{\times}x + b_3{\times}x^2 + ...$

$A_2 = a_2 + a_3{\times}x + a_4{\times}x^2 + ...$ $\quad B_2 = b_2 + b_3{\times}x + b_4{\times}x^2 + ...$

$$C = A \times B = a_0{\times}b_0 + (a_0{\times}b_1 + a_1{\times}b_0)x + (a_0{\times}B_2 + A_1{\times}B_1 + A_2{\times}b_0){\times}x^2$$

↑

$\langle \mathbf{chan}\ c\text{: } rat\cdot\ C = A{\times}B\rangle\ c \quad \Leftarrow \quad (a?\ \|\ b?).\ c!\ a{\times}b.$

$\mathbf{var}\ a0\text{: } rat := a\cdot\ \ \mathbf{var}\ b0\text{: } rat := b\cdot\ \ \mathbf{chan}\ d\text{: } rat\cdot$

→ $\quad \langle \mathbf{chan}\ c\text{: } rat \rightarrow C = A{\times}B\rangle\ d$

$\|\ \ ((a?\ \|\ b?).\ c!\ a0{\times}b + a{\times}b0.\ C = a0{\times}B + D + A{\times}b0)$

$C = a0{\times}B + D + A{\times}b0 \quad \Leftarrow \quad (a?\ \|\ b?\ \|\ d?).\ c!\ a0{\times}b + d + a{\times}b0.\ C = a0{\times}B + D + A{\times}b0$

Power Series Multiplication

Input on channel a : $a_0\ a_1\ a_2$ ...

Input on channel b : $b_0\ b_1\ b_2$ ...

Output on channel c : $c_0\ c_1\ c_2$ ...

$A = a_0 + a_1 \times x + a_2 \times x^2 + \ldots$

$B = b_0 + b_1 \times x + b_2 \times x^2 + \ldots$

$C = c_0 + c_1 \times x + c_2 \times x^2 + \ldots$

$A_1 = a_1 + a_2 \times x + a_3 \times x^2 + \ldots$

$A_2 = a_2 + a_3 \times x + a_4 \times x^2 + \ldots$

$B_1 = b_1 + b_2 \times x + b_3 \times x^2 + \ldots$

$B_2 = b_2 + b_3 \times x + b_4 \times x^2 + \ldots$

$$C = A \times B = a_0 \times b_0 + (a_0 \times b_1 + a_1 \times b_0)x + (a_0 \times B_2 + A_1 \times B_1 + A_2 \times b_0) \times x^2$$

$\langle$**chan** c: $rat \cdot\ C = A \times B \rangle\ c \quad \Leftarrow \quad (a? \parallel b?).\ c!\ a \times b.$

var $a0$: $rat := a\cdot$ **var** $b0$: $rat := b\cdot$ **chan** d: $rat\cdot$

$\langle$**chan** c: $rat \rightarrow C = A \times B \rangle\ d$

→ $\parallel\ ((a? \parallel b?).\ c!\ a0 \times b + a \times b0.\ C = a0 \times B + D + A \times b0)$

$C = a0 \times B + D + A \times b0 \quad \Leftarrow \quad (a? \parallel b? \parallel d?).\ c!\ a0 \times b + d + a \times b0.\ C = a0 \times B + D + A \times b0$

Power Series Multiplication

Input on channel a : $a_0\ a_1\ a_2$ ... $\quad A = a_0 + a_1{\times}x + a_2{\times}x^2 + \ldots$

Input on channel b : $b_0\ b_1\ b_2$ ... $\quad B = b_0 + b_1{\times}x + b_2{\times}x^2 + \ldots$

Output on channel c : $c_0\ c_1\ c_2$ ... $\quad C = c_0 + c_1{\times}x + c_2{\times}x^2 + \ldots$

$A_1 = a_1 + a_2{\times}x + a_3{\times}x^2 + \ldots \qquad B_1 = b_1 + b_2{\times}x + b_3{\times}x^2 + \ldots$

$A_2 = a_2 + a_3{\times}x + a_4{\times}x^2 + \ldots \qquad B_2 = b_2 + b_3{\times}x + b_4{\times}x^2 + \ldots$

$$C = A \times B = a_0{\times}b_0 + (a_0{\times}b_1 + a_1{\times}b_0)x + (a_0{\times}B_2 + A_1{\times}B_1 + A_2{\times}b_0){\times}x^2$$

$\langle$**chan** c: $rat\cdot$ $C = A{\times}B\rangle\ c \quad \Leftarrow \quad (a? \,\|\, b?).\ c!\ a{\times}b.$

var $a0$: $rat := a\cdot$ **var** $b0$: $rat := b\cdot$ **chan** d: $rat\cdot$

$\langle$**chan** c: $rat \to C = A{\times}B\rangle\ d$

$\|\ \ ((a? \,\|\, b?).\ c!\ a0{\times}b + a{\times}b0.\ C = a0{\times}B + D + A{\times}b0)$

$C = a0{\times}B + D + A{\times}b0 \quad \Leftarrow \quad (a? \,\|\, b? \,\|\, d?).\ c!\ a0{\times}b + d + a{\times}b0.\ C = a0{\times}B + D + A{\times}b0$

Power Series Multiplication

Input on channel a : $a_0\ a_1\ a_2\ ...$ $\qquad A = a_0 + a_1{\times}x + a_2{\times}x^2 + ...$

Input on channel b : $b_0\ b_1\ b_2\ ...$ $\qquad B = b_0 + b_1{\times}x + b_2{\times}x^2 + ...$

Output on channel c : $c_0\ c_1\ c_2\ ...$ $\qquad C = c_0 + c_1{\times}x + c_2{\times}x^2 + ...$

$A_1 = a_1 + a_2{\times}x + a_3{\times}x^2 + ...$ $\qquad B_1 = b_1 + b_2{\times}x + b_3{\times}x^2 + ...$

$A_2 = a_2 + a_3{\times}x + a_4{\times}x^2 + ...$ $\qquad B_2 = b_2 + b_3{\times}x + b_4{\times}x^2 + ...$

$$C = A \times B = a_0{\times}b_0 + (a_0{\times}b_1 + a_1{\times}b_0)x + (a_0{\times}B_2 + A_1{\times}B_1 + A_2{\times}b_0){\times}x^2$$

$\uparrow$

$\langle$**chan** c: $rat\cdot$ $C = A{\times}B\rangle\ c \quad \Longleftarrow \quad (a? \,\|\, b?).\ c!\ a{\times}b.$

var $a0$: $rat := a\cdot$ **var** $b0$: $rat := b\cdot$ **chan** d: $rat\cdot$

$\langle$**chan** c: $rat \rightarrow C = A{\times}B\rangle\ d$

$\|\ ((a? \,\|\, b?).\ c!\ a0{\times}b + a{\times}b0.\ C = a0{\times}B + D + A{\times}b0)$

$\uparrow$

$C = a0{\times}B + D + A{\times}b0 \quad \Longleftarrow \quad (a? \,\|\, b? \,\|\, d?).\ c!\ a0{\times}b + d + a{\times}b0.\ C = a0{\times}B + D + A{\times}b0$

Power Series Multiplication

Input on channel a : $a_0\ a_1\ a_2$ ... $\quad A = a_0 + a_1{\times}x + a_2{\times}x^2 + \ldots$

Input on channel b : $b_0\ b_1\ b_2$ ... $\quad B = b_0 + b_1{\times}x + b_2{\times}x^2 + \ldots$

Output on channel c : $c_0\ c_1\ c_2$ ... $\quad C = c_0 + c_1{\times}x + c_2{\times}x^2 + \ldots$

$A_1 = a_1 + a_2{\times}x + a_3{\times}x^2 + \ldots \qquad B_1 = b_1 + b_2{\times}x + b_3{\times}x^2 + \ldots$

$A_2 = a_2 + a_3{\times}x + a_4{\times}x^2 + \ldots \qquad B_2 = b_2 + b_3{\times}x + b_4{\times}x^2 + \ldots$

$$C = A \times B = a_0{\times}b_0 + (a_0{\times}b_1 + a_1{\times}b_0)x + (a_0{\times}B_2 + A_1{\times}B_1 + A_2{\times}b_0){\times}x^2$$

$\langle$**chan** c: $rat\cdot\ C = A{\times}B\rangle\ c \quad \Leftarrow \quad (a? \,\|\, b?).\ c!\ a{\times}b.$

var $a0$: $rat := a\cdot$ **var** $b0$: $rat := b\cdot$ **chan** d: $rat\cdot$

$\langle$**chan** c: $rat \rightarrow C = A{\times}B\rangle\ d$

$\|\ \ ((a? \,\|\, b?).\ c!\ a0{\times}b + a{\times}b0.\ C = a0{\times}B + D + A{\times}b0)$

↑

$C = a0{\times}B + D + A{\times}b0 \quad \Leftarrow \quad (a? \,\|\, b? \,\|\, d?).\ c!\ a0{\times}b + d + a{\times}b0.\ C = a0{\times}B + D + A{\times}b0$

Power Series Multiplication

Input on channel a : $a_0\ a_1\ a_2$ ...

Input on channel b : $b_0\ b_1\ b_2$ ...

Output on channel c : $c_0\ c_1\ c_2$ ...

$A = a_0 + a_1 \times x + a_2 \times x^2 + \ldots$

$B = b_0 + b_1 \times x + b_2 \times x^2 + \ldots$

$C = c_0 + c_1 \times x + c_2 \times x^2 + \ldots$

$A_1 = a_1 + a_2 \times x + a_3 \times x^2 + \ldots$

$A_2 = a_2 + a_3 \times x + a_4 \times x^2 + \ldots$

$B_1 = b_1 + b_2 \times x + b_3 \times x^2 + \ldots$

$B_2 = b_2 + b_3 \times x + b_4 \times x^2 + \ldots$

$$C = A \times B = a_0 \times b_0 + (a_0 \times b_1 + a_1 \times b_0)x + (a_0 \times B_2 + A_1 \times B_1 + A_2 \times b_0) \times x^2$$

$\langle$**chan** c: $rat\cdot$ $C = A{\times}B\rangle\ c$ $\Leftarrow$ $(a? \parallel b?).\ c!\ a{\times}b.$

var $a0$: $rat := a\cdot$ **var** $b0$: $rat := b\cdot$ **chan** d: $rat\cdot$

$\langle$**chan** c: $rat \rightarrow C = A{\times}B\rangle\ d$

$\parallel$ $((a? \parallel b?).\ c!\ a0{\times}b + a{\times}b0.\ C = a0{\times}B + D + A{\times}b0)$

↓ ↓

$C = a0{\times}B + D + A{\times}b0$ $\Leftarrow$ $(a? \parallel b? \parallel d?).\ c!\ a0{\times}b + d + a{\times}b0.\ C = a0{\times}B + D + A{\times}b0$

Power Series Multiplication

Input on channel a : $a_0\ a_1\ a_2$ ... $\qquad A = a_0 + a_1{\times}x + a_2{\times}x^2 + ...$

Input on channel b : $b_0\ b_1\ b_2$ ... $\qquad B = b_0 + b_1{\times}x + b_2{\times}x^2 + ...$

Output on channel c : $c_0\ c_1\ c_2$ ... $\qquad C = c_0 + c_1{\times}x + c_2{\times}x^2 + ...$

$A_1 = a_1 + a_2{\times}x + a_3{\times}x^2 + ...$ $\qquad B_1 = b_1 + b_2{\times}x + b_3{\times}x^2 + ...$

$A_2 = a_2 + a_3{\times}x + a_4{\times}x^2 + ...$ $\qquad B_2 = b_2 + b_3{\times}x + b_4{\times}x^2 + ...$

$$C = A \times B = a_0{\times}b_0 + (a_0{\times}b_1 + a_1{\times}b_0)x + (a_0{\times}B_2 + A_1{\times}B_1 + A_2{\times}b_0){\times}x^2$$

$\langle$**chan** c: rat· $C = A{\times}B\rangle\ c \quad \Leftarrow \quad (a? \parallel b?).\ c!\ a{\times}b.$

var $a0$: $rat := a$· **var** $b0$: $rat := b$· **chan** d: rat·

$\langle$**chan** c: $rat \rightarrow C = A{\times}B\rangle\ d$

$\parallel\ ((a? \parallel b?).\ c!\ a0{\times}b + a{\times}b0.\ C = a0{\times}B + D + A{\times}b0)$

↓ ↓ ↓

$C = a0{\times}B + D + A{\times}b0 \quad \Leftarrow \quad (a? \parallel b? \parallel d?).\ c!\ a0{\times}b + d + a{\times}b0.\ C = a0{\times}B + D + A{\times}b0$

Power Series Multiplication

Input on channel a : $a_0\ a_1\ a_2$ ... $\quad A = a_0 + a_1{\times}x + a_2{\times}x^2 + ...$

Input on channel b : $b_0\ b_1\ b_2$ ... $\quad B = b_0 + b_1{\times}x + b_2{\times}x^2 + ...$

Output on channel c : $c_0\ c_1\ c_2$ ... $\quad C = c_0 + c_1{\times}x + c_2{\times}x^2 + ...$

$A_1 = a_1 + a_2{\times}x + a_3{\times}x^2 + ...$ $\qquad B_1 = b_1 + b_2{\times}x + b_3{\times}x^2 + ...$

$A_2 = a_2 + a_3{\times}x + a_4{\times}x^2 + ...$ $\qquad B_2 = b_2 + b_3{\times}x + b_4{\times}x^2 + ...$

$$C = A \times B = a_0{\times}b_0 + (a_0{\times}b_1 + a_1{\times}b_0)x + (a_0{\times}B_2 + A_1{\times}B_1 + A_2{\times}b_0){\times}x^2$$

$$\uparrow$$

$\langle$**chan** c: rat· $C = A{\times}B\rangle\ c \quad \Leftarrow \quad (a? \parallel b?).\ \ c!\ a{\times}b.$

var $a0$: $rat := a$· **var** $b0$: $rat := b$· **chan** d: rat·

$\langle$**chan** c: $rat \rightarrow C = A{\times}B\rangle\ d$

$\parallel\ ((a? \parallel b?).\ \ c!\ a0{\times}b + a{\times}b0.\ \ C = a0{\times}B + D + A{\times}b0)$

$$\downarrow$$

$C = a0{\times}B + D + A{\times}b0 \quad \Leftarrow \quad (a? \parallel b? \parallel d?).\ \ c!\ a0{\times}b + d + a{\times}b0.\ \ C = a0{\times}B + D + A{\times}b0$

Power Series Multiplication

Input on channel a : $a_0\ a_1\ a_2$ ... $\qquad A = a_0 + a_1{\times}x + a_2{\times}x^2 + ...$

Input on channel b : $b_0\ b_1\ b_2$ ... $\qquad B = b_0 + b_1{\times}x + b_2{\times}x^2 + ...$

Output on channel c : $c_0\ c_1\ c_2$ ... $\qquad C = c_0 + c_1{\times}x + c_2{\times}x^2 + ...$

$A_1 = a_1 + a_2{\times}x + a_3{\times}x^2 + ...$ $\qquad B_1 = b_1 + b_2{\times}x + b_3{\times}x^2 + ...$

$A_2 = a_2 + a_3{\times}x + a_4{\times}x^2 + ...$ $\qquad B_2 = b_2 + b_3{\times}x + b_4{\times}x^2 + ...$

$$C = A \times B = a_0{\times}b_0 + (a_0{\times}b_1 + a_1{\times}b_0)x + (a_0{\times}B_2 + A_1{\times}B_1 + A_2{\times}b_0){\times}x^2$$

↑

$\langle \textbf{chan}\ c{:}\ rat\cdot\ C = A{\times}B\rangle\ c \quad \Leftarrow \quad (a?\ \|\ b?).\ \ c!\ a{\times}b.$

$\textbf{var}\ a0{:}\ rat := a\cdot\ \ \textbf{var}\ b0{:}\ rat := b\cdot\ \ \textbf{chan}\ d{:}\ rat\cdot$

$\langle \textbf{chan}\ c{:}\ rat \rightarrow C = A{\times}B\rangle\ d$

$\|\ \ ((a?\ \|\ b?).\ \ c!\ a0{\times}b + a{\times}b0.\ \ C = a0{\times}B + D + A{\times}b0)$

↓

$C = a0{\times}B + D + A{\times}b0 \quad \Leftarrow \quad (a?\ \|\ b?\ \|\ d?).\ \ c!\ a0{\times}b + d + a{\times}b0.\ \ C = a0{\times}B + D + A{\times}b0$

Power Series Multiplication

Input on channel a : $a_0\ a_1\ a_2$ ... $A = a_0 + a_1{\times}x + a_2{\times}x^2 + ...$

Input on channel b : $b_0\ b_1\ b_2$ ... $B = b_0 + b_1{\times}x + b_2{\times}x^2 + ...$

Output on channel c : $c_0\ c_1\ c_2$ ... $C = c_0 + c_1{\times}x + c_2{\times}x^2 + ...$

$A_1 = a_1 + a_2{\times}x + a_3{\times}x^2 + ...$ $B_1 = b_1 + b_2{\times}x + b_3{\times}x^2 + ...$

$A_2 = a_2 + a_3{\times}x + a_4{\times}x^2 + ...$ $B_2 = b_2 + b_3{\times}x + b_4{\times}x^2 + ...$

$$C = A \times B = a_0{\times}b_0 + (a_0{\times}b_1 + a_1{\times}b_0)x + (a_0{\times}B_2 + A_1{\times}B_1 + A_2{\times}b_0){\times}x^2$$

↑

⟨**chan** c: rat· $C = A{\times}B$⟩ c ⇐ $(a? \parallel b?).\ c!\ a{\times}b.$

var $a0$: $rat := a$· **var** $b0$: $rat := b$· **chan** d: rat·

⟨**chan** c: $rat \rightarrow C = A{\times}B$⟩ d

$\parallel$ $((a? \parallel b?).\ c!\ a0{\times}b + a{\times}b0.\ C = a0{\times}B + D + A{\times}b0)$

↓

$C = a0{\times}B + D + A{\times}b0$ ⇐ $(a? \parallel b? \parallel d?).\ c!\ a0{\times}b + d + a{\times}b0.\ C = a0{\times}B + D + A{\times}b0$

Power Series Multiplication

Input on channel a : $a_0\ a_1\ a_2$ ... $\qquad A = a_0 + a_1{\times}x + a_2{\times}x^2 + ...$

Input on channel b : $b_0\ b_1\ b_2$ ... $\qquad B = b_0 + b_1{\times}x + b_2{\times}x^2 + ...$

Output on channel c : $c_0\ c_1\ c_2$ ... $\qquad C = c_0 + c_1{\times}x + c_2{\times}x^2 + ...$

$A_1 = a_1 + a_2{\times}x + a_3{\times}x^2 + ...$ $\qquad B_1 = b_1 + b_2{\times}x + b_3{\times}x^2 + ...$

$A_2 = a_2 + a_3{\times}x + a_4{\times}x^2 + ...$ $\qquad B_2 = b_2 + b_3{\times}x + b_4{\times}x^2 + ...$

$$C = A \times B = a_0{\times}b_0 + (a_0{\times}b_1 + a_1{\times}b_0)x + (a_0{\times}B_2 + A_1{\times}B_1 + A_2{\times}b_0){\times}x^2$$

$\langle$**chan** c: $rat\cdot$ $C = A{\times}B\rangle\ c \quad \Leftarrow \quad (a? \parallel b?).\ c!\ a{\times}b.$

var $a0$: $rat := a\cdot$ **var** $b0$: $rat := b\cdot$ **chan** d: $rat\cdot$

$\langle$**chan** c: $rat \rightarrow C = A{\times}B\rangle\ d$

$\parallel\ ((a? \parallel b?).\ c!\ a0{\times}b + a{\times}b0.\ C = a0{\times}B + D + A{\times}b0)$

↓

$C = a0{\times}B + D + A{\times}b0 \quad \Leftarrow \quad (a? \parallel b? \parallel d?).\ c!\ a0{\times}b + d + a{\times}b0.\ C = a0{\times}B + D + A{\times}b0$

Power Series Multiplication

Input on channel a : $a_0\ a_1\ a_2$ ... $A = a_0 + a_1{\times}x + a_2{\times}x^2 + \ldots$

Input on channel b : $b_0\ b_1\ b_2$ ... $B = b_0 + b_1{\times}x + b_2{\times}x^2 + \ldots$

Output on channel c : $c_0\ c_1\ c_2$ ... $C = c_0 + c_1{\times}x + c_2{\times}x^2 + \ldots$

$A_1 = a_1 + a_2{\times}x + a_3{\times}x^2 + \ldots$ $B_1 = b_1 + b_2{\times}x + b_3{\times}x^2 + \ldots$

$A_2 = a_2 + a_3{\times}x + a_4{\times}x^2 + \ldots$ $B_2 = b_2 + b_3{\times}x + b_4{\times}x^2 + \ldots$

$$C = A \times B = a_0{\times}b_0 + (a_0{\times}b_1 + a_1{\times}b_0)x + (a_0{\times}B_2 + A_1{\times}B_1 + A_2{\times}b_0){\times}x^2$$

$\langle$**chan** c: $rat\cdot\ C = A{\times}B\rangle\ c \quad \Leftarrow \quad (a? \,\|\, b?).\ c!\ a{\times}b.$

var $a0$: $rat := a\cdot$ **var** $b0$: $rat := b\cdot$ **chan** d: $rat\cdot$

$\langle$**chan** c: $rat \rightarrow C = A{\times}B\rangle\ d$

$\|\ ((a? \,\|\, b?).\ c!\ a0{\times}b + a{\times}b0.\ C = a0{\times}B + D + A{\times}b0)$

$C = a0{\times}B + D + A{\times}b0 \quad \Leftarrow \quad (a? \,\|\, b? \,\|\, d?).\ c!\ a0{\times}b + d + a{\times}b0.\ C = a0{\times}B + D + A{\times}b0$

Power Series Multiplication

Input on channel a : $a_0\ a_1\ a_2\ ...$ $\quad A\ =\ a_0 + a_1{\times}x + a_2{\times}x^2 + ...$

Input on channel b : $b_0\ b_1\ b_2\ ...$ $\quad B\ =\ b_0 + b_1{\times}x + b_2{\times}x^2 + ...$

Output on channel c : $c_0\ c_1\ c_2\ ...$ $\quad C\ =\ c_0 + c_1{\times}x + c_2{\times}x^2 + ...$

$A_1\ =\ a_1 + a_2{\times}x + a_3{\times}x^2 + ...$ $\quad B_1\ =\ b_1 + b_2{\times}x + b_3{\times}x^2 + ...$

$A_2\ =\ a_2 + a_3{\times}x + a_4{\times}x^2 + ...$ $\quad B_2\ =\ b_2 + b_3{\times}x + b_4{\times}x^2 + ...$

$$C\ =\ A \times B\ =\ a_0{\times}b_0 + (a_0{\times}b_1 + a_1{\times}b_0)x + (a_0{\times}B_2 + A_1{\times}B_1 + A_2{\times}b_0){\times}x^2$$

$\langle \mathbf{chan}\ c\text{: } rat\cdot\ C = A{\times}B\rangle\ c \quad \Leftarrow \quad (a? \,\|\, b?).\ \ c!\ a{\times}b.$

$\longrightarrow \quad \mathbf{var}\ a0\text{: } rat := a\cdot\ \ \mathbf{var}\ b0\text{: } rat := b\cdot\ \ \mathbf{chan}\ d\text{: } rat\cdot$

$\quad \langle \mathbf{chan}\ c\text{: } rat \to C = A{\times}B\rangle\ d$

$\| \quad ((a? \,\|\, b?).\ \ c!\ a0{\times}b + a{\times}b0.\ \ C = a0{\times}B + D + A{\times}b0)$

$C = a0{\times}B + D + A{\times}b0 \quad \Leftarrow \quad (a? \,\|\, b? \,\|\, d?).\ \ c!\ a0{\times}b + d + a{\times}b0.\ \ C = a0{\times}B + D + A{\times}b0$

Power Series Multiplication

Input on channel a : $a_0\ a_1\ a_2\ ...$ $\qquad A = a_0 + a_1{\times}x + a_2{\times}x^2 + ...$

Input on channel b : $b_0\ b_1\ b_2\ ...$ $\qquad B = b_0 + b_1{\times}x + b_2{\times}x^2 + ...$

Output on channel c : $c_0\ c_1\ c_2\ ...$ $\qquad C = c_0 + c_1{\times}x + c_2{\times}x^2 + ...$

$A_1 = a_1 + a_2{\times}x + a_3{\times}x^2 + ...$ $\qquad B_1 = b_1 + b_2{\times}x + b_3{\times}x^2 + ...$

$A_2 = a_2 + a_3{\times}x + a_4{\times}x^2 + ...$ $\qquad B_2 = b_2 + b_3{\times}x + b_4{\times}x^2 + ...$

$$C = A \times B = a_0{\times}b_0 + (a_0{\times}b_1 + a_1{\times}b_0)x + (a_0{\times}B_2 + A_1{\times}B_1 + A_2{\times}b_0){\times}x^2$$

$$\langle \textbf{chan}\ c{:}\ rat\cdot\ C = A{\times}B\rangle\ c \quad \Leftarrow \quad (a? \parallel b?).\ \ c!\ a{\times}b.$$

$$\textbf{var}\ a0{:}\ rat := a\cdot\ \ \textbf{var}\ b0{:}\ rat := b\cdot\ \ \textbf{chan}\ d{:}\ rat\cdot$$

$$\longrightarrow \quad \langle \textbf{chan}\ c{:}\ rat \rightarrow C = A{\times}B\rangle\ d$$

$$\longrightarrow \quad \parallel\ ((a? \parallel b?).\ \ c!\ a0{\times}b + a{\times}b0.\ \ C = a0{\times}B + D + A{\times}b0)$$

$$C = a0{\times}B + D + A{\times}b0 \quad \Leftarrow \quad (a? \parallel b? \parallel d?).\ \ c!\ a0{\times}b + d + a{\times}b0.\ \ C = a0{\times}B + D + A{\times}b0$$